

# VERMONT CONSTRUCTION SPECIFICATION

## 50HT – FENCE, HIGH TENSILE ELECTRIC WIRE

### 1. Scope

This work shall consist of furnishing and installing permanent high tensile electric fence and related essential components. Unless otherwise specified, complete electric high tensile fence systems constructed in strict accordance to manufacturer's specifications and recommendations will be accepted as an equivalent substitute to this specification.

### 2. Materials

**Waste Storage Facilities:** High tensile fence installed around waste storage facilities and other high hazard areas shall have a minimum of six strands of high tensile wire with the top strand 48 inches above the ground line.

**Pasture/Grazing/Use Exclusion:** For all other uses the height, number of strands and wire spacing will be determined by the on site NRCS representative with the proper design approval authority. Fence shall be constructed with 14 to 16 gauge high tensile wire. Barbed wire shall not be used in conjunction with high tensile fence.

#### a. Wire

Wire shall be new, smooth, and meet or exceed the following:

- (1) Gauge – 12.5  
Tensile Strength – 170,000 psi (minimum)  
Galvanizing – Class 3  
Breaking Strength – 1,300 lbs. (minimum)
- (2) Gauge – 14  
Tensile Strength – 200,000 psi (minimum)  
Galvanizing – Class 3  
Breaking Strength – 955 lbs. (minimum)
- (3) Gauge – 16  
Tensile Strength – 200,000 psi (minimum)  
Galvanizing – Class 3  
Breaking Strength – 585 lbs. (minimum)

#### b. Fasteners

**Staples** shall be of 9 gauge galvanized steel or heavier with a minimum length of 1-3/4 inches for softwood and a minimum length of 1 inch for close-grained hardwoods.

**Manufacturer's clips** or 14 gauge, class 3 galvanized wire may be used to fasten wires to steel posts.

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### c. Posts

**Wood.** All wooden posts and brace members shall be red cedar, black locust, or pressure treated. Pressure treated posts shall be treated with a minimum of 0.40 lbs/cubic foot of chromated copper arsenate (CCA) Type A, B, or C; or ammoniated copper quat (ACQ) preservative by a method to ensure that complete penetration of the sap wood is obtained. Quality of treated wood shall provide sufficient strength and last the expected life of the fence. All bark shall be removed from red cedar and black locust posts. At least half of the diameter of the red cedar shall be heartwood.

All corner, end, pull and gate assembly posts shall be wooden with a minimum diameter of 6 inches. Assembly post shall be a minimum of 9 feet long for single H-brace assemblies and 8 feet long for double H-brace assemblies.

Line posts shall be at least 4 inches in diameter. Wood line posts shall be a minimum length of 7 feet.

**Plastic.** Plastic line post shall be at least 4 inches in diameter, able to accept and hold staples, and be durable for the life of the fence. Plastic line post shall be a minimum length of 7 feet.

**Steel.** Steel line post shall have the standard "T" section, nominal dimensions of 1-3/8" x 1-3/8" x 1/8" with anchor plate. The post shall weigh at least 1.25 pounds per length and painted with weather resistant paint. The post shall be studded to aid in wire attachment. Steel line posts shall be a minimum length of 6 feet.

**Other.** Other materials may be used for line and assembly posts if they are equal or greater in strength and quality of above. Other materials must be approved by the engineer.

### 3. Construction

#### a. Post Installation and Spacing.

Live trees used for corner, bracing, and line posts shall have a diameter breast height (DBH) equal to or greater than what is required for normal wooden posts. Some alignment variations shall be allowed, but caution should be taken to minimize offsets and prevent excess fence needs. Wire or insulators will not be fastened directly to trees. A board or boards will be placed on the tree to keep the wire from contacting the bark. Wire shall not be wrapped around the tree. A CCA treated 2"x6" board, fiberglass strip, plastic strip, or an untreated red cedar or white oak board with a minimum size of 1"x4" must be securely fastened to the tree with at least three 40 lbs pole barn nails. The board must be long enough to accommodate the wire. The fence will be fastened to the board with staples

#### b. Corner, End, Pull and Gate Assemblies.

If the posts are to be set or driven to four feet below the ground line, a single H-brace assembly shall be used.

If the posts are to be set or driven to three feet below the ground line, a double H-brace assembly shall be used.

Bracing is required at all corner, gates, pull, and end assemblies.

All brace members shall be wood and the member centerline shall be 4 to 9 inches below the top of the post. Other brace materials maybe used as approved by the engineer.

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The brace member shall be 4 inches in diameter and a minimum of 7 feet in length. A tension member composed of 2 complete loops of 9 gauge smooth wire, 12 gauge double strand wire, or a single loop of 12.5 gauge high tensile strength smooth wire shall be used. One end of the tension member shall be at the height of the horizontal brace member and the other end shall be 4 inches above the ground line on the other posts.

A corner assembly shall be used when the horizontal alignment changes more than 15 degrees and when the vertical alignment changes more than 15 degrees.

### **c. Line Post.**

Wooden and plastic line post shall be set or driven 34 inches below the ground line. All wooden posts will be at least 2 inches higher than the top strand of the fence to prevent splitting when attaching the fence. All post of other materials shall be at least 1 inch higher than the top strand of the fence.

If soil depth is less than 28 inches, use standard "T" section posts. Steel line posts shall be set or drive 23 inches below the ground line.

If posts are not driven, the backfill around the post shall be thoroughly compacted.

In areas where soil depth restricts the required embedment depth, additional anchors or deadman applied against the direction of pull, shall be used.

Spacing of line posts and stays depends upon terrain and the number of wires. Maximum post spacing shall be as follows:

- One and two strand fences may have line posts spaced up to 100 feet apart with no stays, or up to 150 feet apart with stays or light posts every 50 feet.
- Three or more strand fences may have line post spaced up to 50 feet with apart with no stays, or up to 150 feet apart with stays or light posts every 50 feet.

Posts in dips shall be installed so that they will not pull out of the soil. Two-inch or smaller posts will be anchored or wooden post (3 inches in diameter) set to sufficient depth to resist pull out.

Offset brackets made of galvanized high tensile spring wire with insulators of high density polyethylene with ultra-violet stabilizer or porcelain can be attached to standard barbed wire fence or woven wire fence to provide transmission line and/or to protect a standard fence. Place offset brackets no further than 60 feet apart and attach to wires of standard fence next to post. If control of animals is desired, place offset brackets at 2/3 the shoulder height of the animals. Ensure that no wires of the old fence comes in contact with the electric fence wire, as a short circuit will occur.

### **d. Wire Spacing and Fasteners.**

For dairy cattle, the top strand shall be 48 inches above the ground line. The bottom stand shall be 8" above the ground line. Distance between strands shall be 8 inches.

The top wire shall be at least 2 inches below the top of wooden posts and 1 inch below the top of steel posts

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The tension on the high tensile wire should be 100 lbs. on each strand. Tension will be applied with an in-line stretcher on each strand. Tension will be applied with an in-line stretcher on each strand. To gauge tension, install a tension spring on at least one strand of wire.

Staples shall be driven diagonally to the wood's grain and at a slight downward angle, (upward if pull is up) to avoid splitting the post and loosening of the staple. Space should be left between the inside crown of the staple and the post to permit free movement of wire. Barbed staples shall be used for pressure treated posts.

Wires may be attached to steel posts by manufacturer's clips or by two turns of 14 gauge galvanized wire.

Live trees used for corner, bracing, and line posts shall have a diameter breast height (DBH) equal to or greater than those prescribed for normal wooden posts. Some alignment variation shall be allowed, but caution should be taken to minimize offsets and prevent excess fencing needs. Wires or insulators will not be fastened directly to trees. Were appropriate, a pressure treated 2" x 6", fiberglass strip, plastic strip, or an untreated white oak board with a minimum size of 1" x 4" must be securely fastened to the tree with at least three 40 lbs. pole barn nails. The board must be long enough to accommodate the wire. The fence will be fastened to the board or 2" x 6" with staples. A board or boards will be placed on the tree to keep the wire from contacting the bark. Wire will not be wrapped around the any tree.

**Table 1 – Recommended Wire Spacing and Charge (+/-)**

Wires	Animal Type	Fence Height (inches)	Spacing from Ground (Inches)
1	Cattle Hogs	26 to 32 12	26 to 32(+) 12(+)
2	Cattle Sheep & Goats Hogs	26 to 36 20 to 30 18	18 to 24(+/-), 24 to 36(+) 8 to 10(+), 20 to 30(+) 6(+), 18(+)
3	Calves Sheep & Goats Cattle & Horses Hogs	34 to 44 32 46 18	11 to 18(+/-), 23 to 30(-), 34 to 44(+) 10(+), 20(+/-), 32(+) 20(+), 34(+/-), 46(+) 6(+), 12(+), 18(+)
4	Cattle Sheep & Goats	40 30 to 38	8(+/-), 18(+), 28(+/-), 40(+) 6 to 16(+/-), 12 to 22(+), 18 to 30(+/-), 30 to 38(+)
5	Cattle & Horses Sheep & Goats	50	10(+), 20(+/-), 30(+), 40(+/-), 50(+)
6 to 8	Deer Predators	52 to 62	4 to 6(+), 6 to 8(-), 12(+), 18(-), 24(+), 30(+/-), 40(+/-), 52(+)

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Wire shall be spliced by means of “Western Union” splice or by suitable splice sleeves applied with a tool design for the purpose. The “Western Union” splice shall have not less than 8 wraps at each end about the other. All wraps shall be tightly wound and closely spaced.

### **e. Interior Fences.**

For 1 to 3 strand wire electric fences, corner, gate, end and brace post assemblies may consist of the following:

- Steel “T” posts that are a minimum of 1.25 pounds per one foot of length with appropriate knee, deadman, angle plate, anchor, H-brace.
- Wood posts with a minimum top diameter of 4 inches, set 36 inches in the ground with appropriate knee, deadman, angle plate, anchor, or H-brace.
- Wood, steel pipe, or fiberglass posts with a minimum diameter of 2 inches, set 36 inches in the ground with appropriate knee, deadman, angle plate, or H-brace.
- Steel pipe or fiberglass posts with a minimum diameter of 2 inches if set in concrete to a depth of 24 inches.
- Steel pipe or fiberglass posts with a minimum diameter of 1 inch with appropriate angle bracing and sufficient ground anchoring to maintain wire tension to remain firmly anchored and stay erect.

### **f. Four Strand Electric Fence.**

Single H-brace assemblies shall be used. Post will be 5 inch nominal wood. Post must be set or driven a minimum of 36 inches below the ground line.

All wood posts will be at least 2 inches higher than the top wire of the fence to prevent splitting when attaching insulators.

All posts of other materials shall be at least 1 inch higher than the top wire of the fence.

### **g. Energizers.**

Electronic energizers or power fence controllers shall be installed according to the manufacturer’s recommendations and will meet the following minimum specifications.

- High power, low impedance system with solid state circuitry capable of at least 5,000 volts peak output and a short pulse that is less than 300 mAmps in intensity, finished within 0.0003 of a second and a rate of 35 to 65 pulses per minute.
- High impact weather resistant cases.
- 110 volt, 220 volt, or 12 volt battery power capable of operating 3 weeks without recharging. If the length of fence requires an energizer of more than 4 joules, a solar charger will be needed on the battery system.
- The accepted figures for minimum voltage for livestock control are: cattle – 1600v; sheep and hair goats – 2000v; hogs, horses, and meat goats – 1200v.
- Safety pace fused to prevent over pulsing.

Rule of thumb, the energizer should be capable of producing 1 joule of energy for each mile of planned fence when average energy losses to the system is expected.

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### **h. Grounding.**

All electric fences must be properly grounded. The energizer ground wire should be connected to a galvanized pipe or ½ inch diameter or larger rod. Ground rod should be buried 3 feet for every 1 joule of energy out put. (ie. If the energizer produces 3 joules, ground rod should be buried 9 feet).

Ground rod should be buried where soil remains moist for best results. Drive 6 to 8 feet rods into the ground at least 10 feet apart to provide the required amount of ground rod. Connect a continuous ground wire from the energizer to each rod with a galvanized steel or aluminum clamp. Copper rods with copper wire may be used if the energizer terminals are stainless steel or copper. If the energizer terminals are not stainless steel or copper, do not use copper ground rods due to corrosion at the connection and subsequent loss of electrical continuity. Use copper clamps with copper wire and copper rods. The ground wire(s) of the fence may be connected to the same ground as the energizer or separate ground with the same size and depth requirement.

More ground rods may be needed for system to function properly. Follow the manufacturer's recommendations for the number of ground rods

Do not use the grounding system for other existing applications, such as power poles, breaker boxes, and milking barns. At least 25 feet should separate the fence grounding system from any other grounding system.

### **i. Lightning Protection.**

Lightning can cause damage to the energizer. Most energizers are poorly protected from lightning strikes. External lightning arrestors and an induction loop (lightning choke) should be installed for added protection. Lightning arrestor grounding rods should be placed at least 65 feet from the energizer.

Install an additional set of ground rods and attach to a lightning arrestor. Use at least one more ground rod on the arrestor than was used for the energizer. Attach the lightning arrestor to the wires of the fence. Install a lightning choke in the fence line immediately between the lightning arrestor and the energizer. The lightning arrestor ground must be better than the energizer ground for it to function properly, because lightning will seek the least resistant route to the ground.

### **j. Spike Protection.**

A voltage spike protector is recommended for use with 120 and 140 volt energizers. Also, a ground rod should be installed at the electric company's transformer pole (primary ground) and another ground rod installed at the electrical circuit breaker box (secondary ground), if they do not already exist. Additionally, a surge protector should be installed between the energizer and the power supply.

### **k. Insulation and Insulated Cable.**

Insulation used for positively charged wire(s) must be high-density polyethylene with ultra-violet stabilizer or high-density polypropylene with ultra-violet stabilizer.

All underground wire(s) installations must be double insulated; molded or high tensile strength steel, 14 gauge or larger wire. The insulation must be high density polyethylene with ultra-violet stabilizer or high density polypropylene with ultra-violet stabilizer.

Insulators for steel and other conductive material posts shall be capable of

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withstanding at least 10,000 volts of current leakage and shall be made of high density polyethylene with ultra-violet stabilizer, high density polypropylene with ultra-violet stabilizer, or porcelain.

Insulators for end, corner, and angle braces shall be capable of withstanding at least 10,000 volts of current leakage and shall be made of high density polyethylene with ultra-violet stabilizer, high density polypropylene with ultra-violet stabilizer, or porcelain. Red insulators should not be used as they might attract hummingbirds.

Use insulated galvanized wire to cross gates in areas where electrical shocks to humans and livestock should be prevented (eg. working facilities). For underground burial, use wire designed for burial. Placing buried cable inside plastic pipe helps to decrease the incidence of short-circuiting. When overhead transmission is used, height should be sufficient so as not to impede the movement of livestock or equipment. Do not use insulated copper wire due to corrosion at the splice and lack of tensile strength.

### **I. Gates.**

Electrified gates maybe constructed of a single straight wire, galvanized cable, or poly-tape with a spring loaded insulated handle, or an expandable coiled high tensile 12.5 gauge wire attached to an insulated handle. The number of wires shall be determined by the fence objective. The gate shall be constructed so that it is non-electrified when the gate is open. Overhead or underground transmissions lines will be used to carry electricity past the gate to the remainder of the fence when the gate is open.

An electrified floodgate maybe used in lieu of a non-electrified gate, if desired. The electrified floodgate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach droppers of 12.5 gauge high tensile fence wire, galvanized cable, or galvanized chains to electrified wire at a spacing of six inches above average normal water level. Connect gate to electric fence with double insulated cable through a cut-off switch and floodgate controller. If flooding is expected to last some time, switch the floodgate off.

### **m. Fencing at Depressions.**

Where fencing is installed parallel to the ground surface, the line posts and/or battens subject to upward pull shall be anchored by means of extra embedment or by special anchors labeled for such applications, or as detailed on the drawings.

Where the fence is installed with the top wire straight and parallel to the ground surface on either side of the depression, extra length posts shall be used to allow normal post embedment. Unless otherwise specified, extra space between the bottom of the fence and ground shall be closed with extra strands of wire properly anchored.

### **n. Crossing Water Course.**

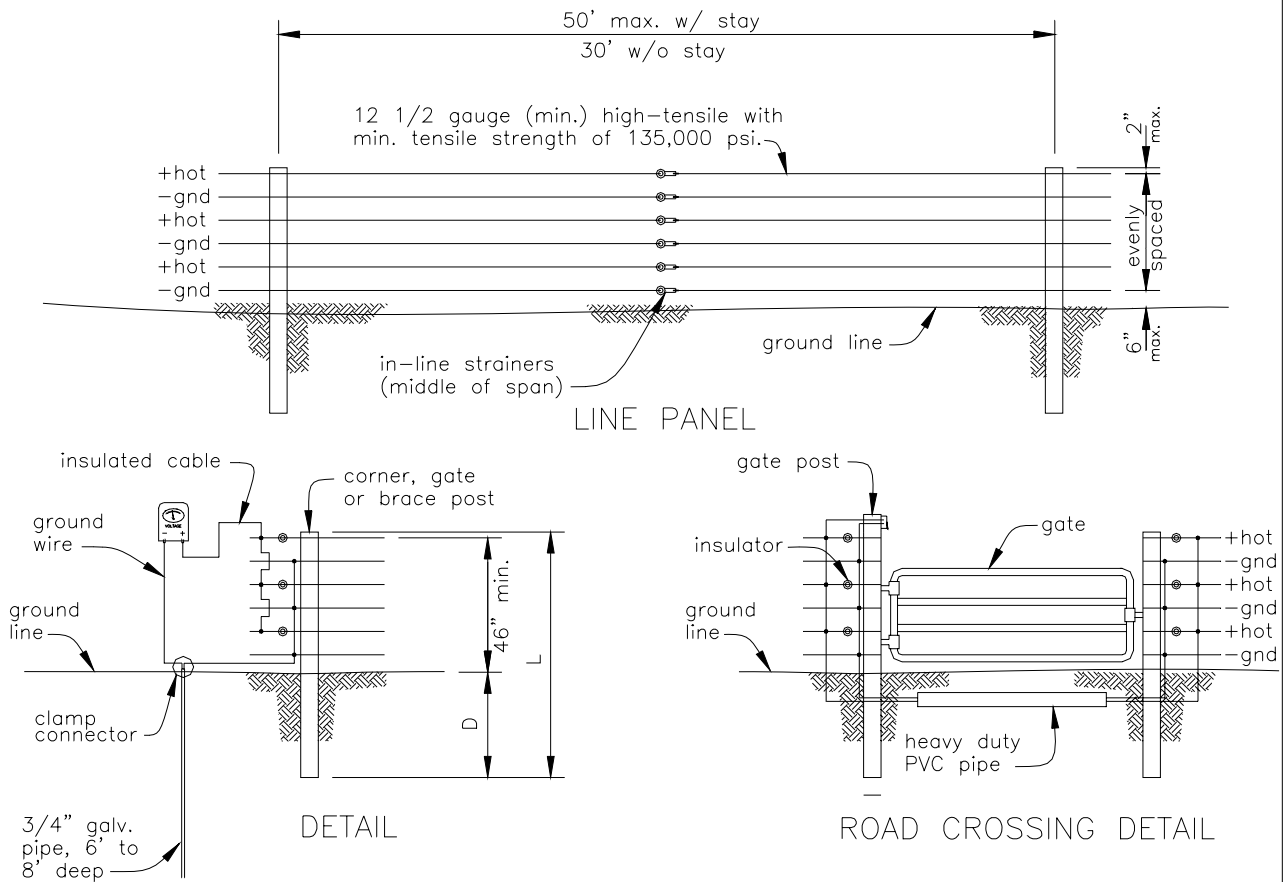
Where the fence crosses small watercourses, end the main fence at the top of the streambank on each side with an appropriate end assembly. From separate posts driven next to end posts, construct a separate section of fence across the watercourse that shall be manually or automatically de-energized during high flow or flooding conditions. The only tie between the main fence and the section

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spanning the watercourse shall be a single electrical connection. In addition, an insulated overhead wire shall be erected to maintain electrical continuity with the fence on the other side of the watercourse.

Where the fence crosses larger watercourses or areas prone to frequent flooding or ice flow capable of carrying debris which could significantly impair the functioning of the fence, special provisions shall be made, such as a breakaway fence, temporary portable fence, or laying the wire on the ground.





LINE POSTS: Wood (3 inch. dia. min.)

L = 6 ft. min.  
D = 2 ft. min.

CORNER, GATE, BRACE POSTS: Wood (6 inch. dia. min.)

L = 7 ft. min.  
D = 3 ft. min.

ENERGIZERS: 110-volt or 220-volt line-powered  
12-volt battery solar-powered

STAYS: Wood  
Fiberglass

FASTENERS: Porcelain insulators  
Plastic insulators

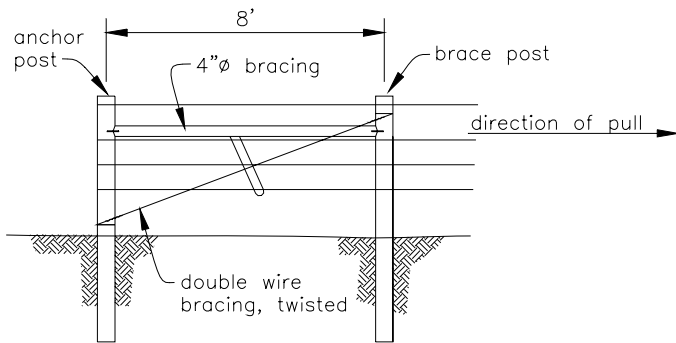
SPECIES for all wood: White Cedar  
Black Locust  
Any Pressure Treated Species

GALVANIZING shall be at least Class III as per ASTM A-121.

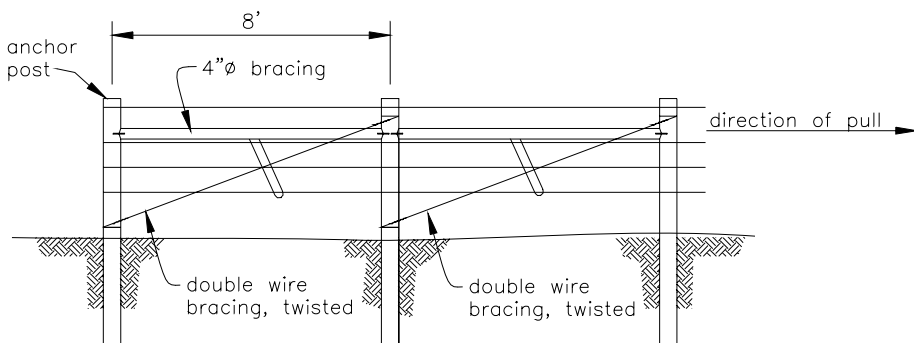
SPECIAL INSTRUCTIONS:

Drawing not to scale. Standardized drawing must be adapted to the specific site.

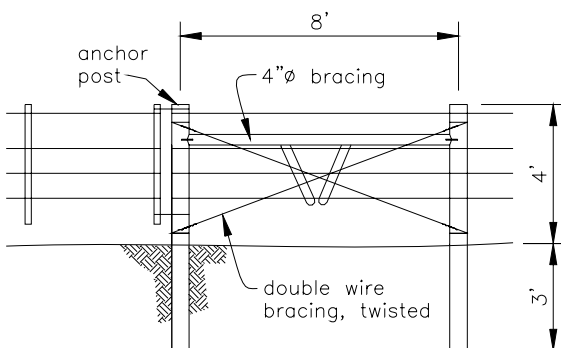
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1-SPAN END



2-SPAN END

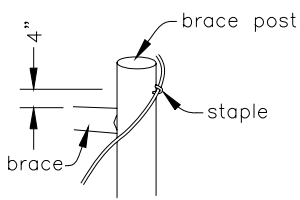


GATE BRACE

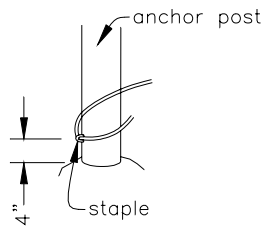
1. Double wrap all bracing.
2. All brace posts to be 7' long, 3' embedment.
3. Dap braces into posts.
4. Spike braces to posts.

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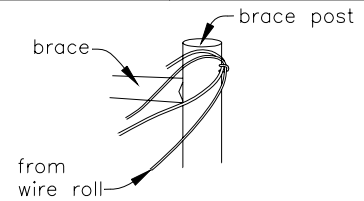
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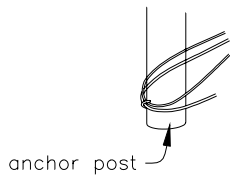
Drive staple about half its length into brace post about 4 inches above brace member on opposite side from brace.



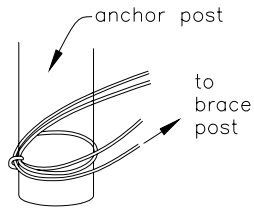
Drive staple in similar manner on anchor post about 4 inches from ground line opposite side of brace.



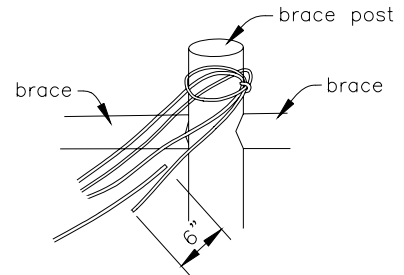
Unroll enough brace wire for two complete loops around anchor and brace post.



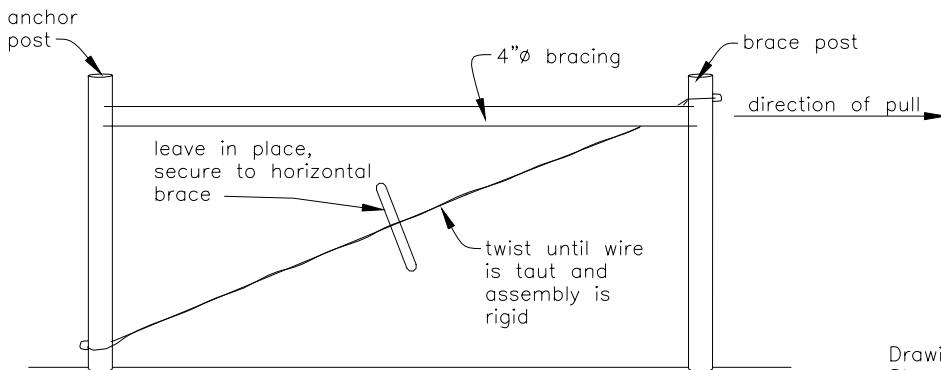
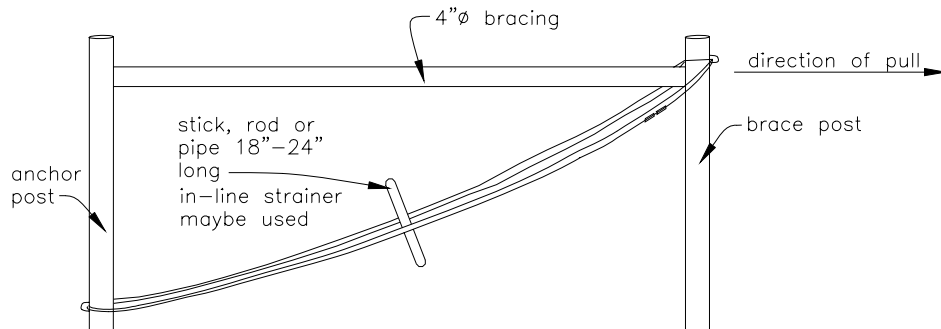
Thread end of brace wire through one staple and then through the other. Repeat to from three wire strands.



Wrap wire around anchor post and return toward brace post.



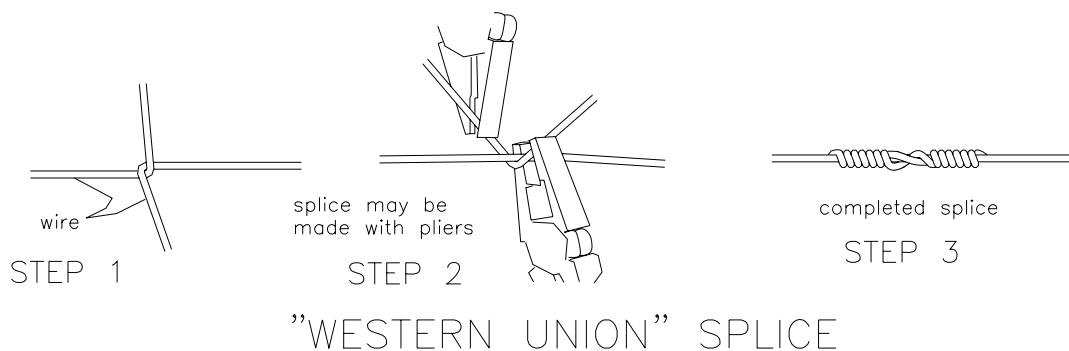
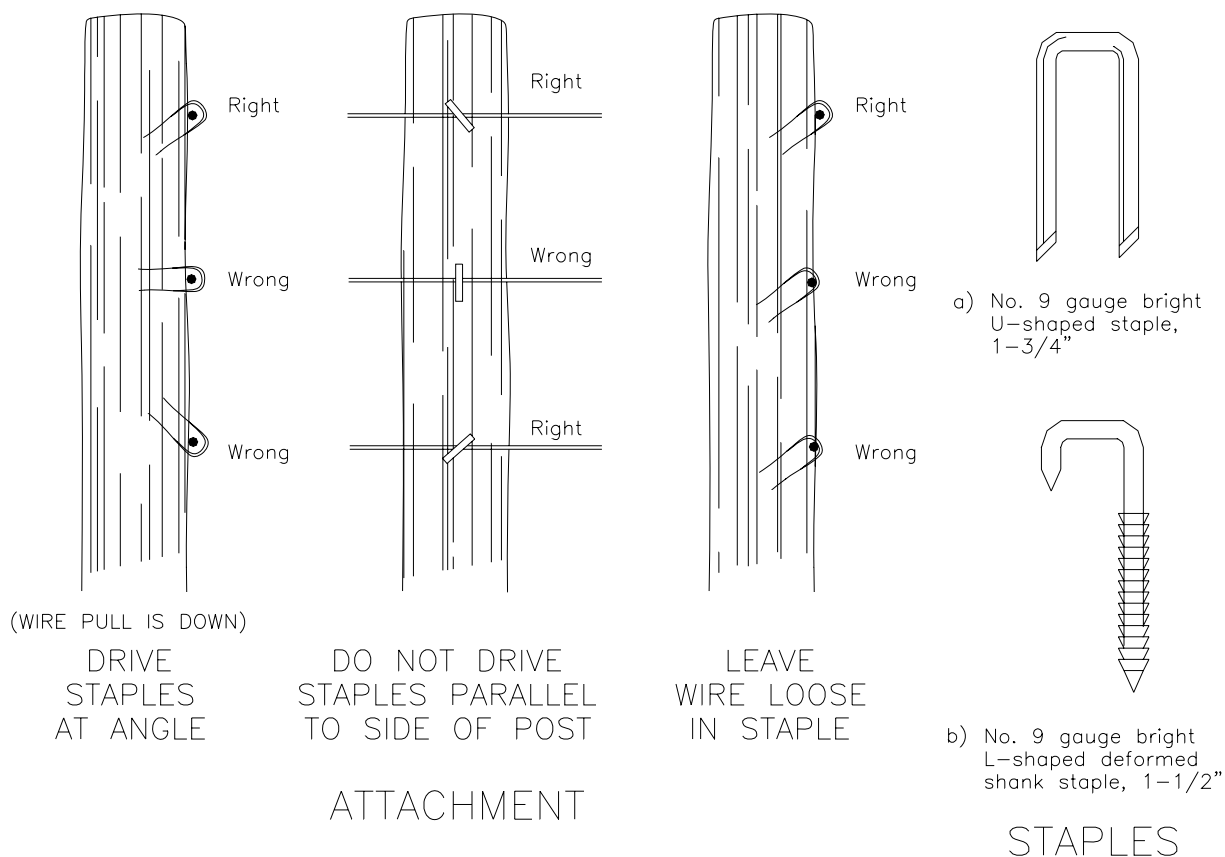
Cut brace wire from roll allowing enough wire to wrap around brace post and extend 6 to 12 inches past other wire end. Make splice.



BRACE

Drawing not to scale.  
Standardized drawing  
must be adapted to  
the specific site.

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